LAB-82-02

Noise Exposure Assessment in MTC Snowplows

C.T. Blaney
Acoustics Research Technician
Experimental Demonstration and Testing
Research and Development Branch

Published by:
The Policy Planning and Research Division
Ontario Ministry of Transportation and Communications
Hon. James W. Snow, Minister
H.F. Gilbert, Deputy Minister

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ABSTRACT

This report presents an evaluation of the noise exposure of highway equipment operators while plowing snow. The evaluation was carried out on four trucks at two patrol yards during the months of February and March, 1982.

Results indicate that the workers are not exposed to sound levels above the current Ministry of Labour regulations of 90 dBA for 8 h.

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1/ INTRODUCTION

A noise exposure study at two patrol yards was carried out during the months of February and March, 1982. The objective of the study was to evaluate the average noise exposure of highway snowplow operators.

Noise dosimeters were used as measuring instruments. Readings were in terms of noise dose and were later converted into equivalent continuous noise levels according to a continuous type expansion. An exchange rate of 5 dBA amplitude/time criterion as specified in the American "Occupational Safety and Health Act" (OSHA) was used.

2/ PROCEDURE

2.1/ INSTRUMENTATION

2.1.1/ Dosimeters

Four dosimeters, Bruel & Kjaer, type 4431, were used during the test. The instruments had a low sound level cut-off of 85 dBA.

Dosimeters consist basically of a microphone, a processor and a memory circuit. A direct read-out of the percentage of noise dose received is obtained from the instrument. A noise dose of 100% equals an average L_{OSHA} level of 90 dBA. External calibration of the instrument is necessary using a Bruel & Kjaer calibrator, type 4230.

There is a relationship between noise dose and the energy equivalent noise level (L_{OSHA}) which is the level of a continuous, steady-state noise that would be equivalent to the time-varying noise level, in dBA, which was present at the measurement location. From a noise dose percentage reading, the noise exposure (L_{OSHA}) was computed using a nomograph supplied with the dosimeter.

2.1.2/ Sound Level Meter

A sound level meter, Bruel & Kjaer, type 2218, was used to perform a number of tests.

The sound level meter was used to perform the tests of the maximum interior sound level in snowplows. The results are summarized in Table 6. Meter calibration was performed before and after the measurements using a Bruel & Kjaer calibrator, type 4220.

2.2/ MEASUREMENT TECHNIQUE

At the beginning of the study, the highway equipment operators were told the purpose of the study.

Testing was only done on the days that a snowfall took place and on the shifts that subsequently plowed the snow. Measurements took place only

during the hours of each shift in which plowing actually occurred. Testing routines started with the checking and calibration of the dosimeters. Care was taken to ensure that the dosimeters were started when the plows were about to depart from the patrol yards. Dosimeters were placed in the operators' shirt pockets and the microphones were attached to their collars. Care was taken to point the microphones outwards from the collar, facing towards the centre of the vehicle. The operators were told to wear the instruments until they returned to the patrol yards, at which time noise dose percentage readings were obtained and the instruments' calibration could be checked.

It was not possible for a technician to be in the truck, because the vehicle cab would only hold a driver and wingman. For this reason, additional readings were taken in the trucks when it was possible to have a technician present. Static testing, using the method outlined in the Canadian Standards Association standard Z107.23-M1977, was used to obtain the maximum interior sound level in each truck.

3/ RESULTS

Tables 1 and 3 show the results of each testing session and provide the L_{OSHA} level at two positions in the truck. Tables 2 and 4 show the average L_{OSHA} ($\bar{L}_{OSHA}$) and the standard deviation from the mean at each position in each truck. Table 5 shows the overall average sound levels in each truck. Table 6 shows the results of the static testing performed on the trucks.

4/ DISCUSSION

The results given in Tables 1 to 5 were measured during those periods of snowplow operations which lasted less than the entire 8 h shift.

The results varied from a high of L_{OSHA} 91.0 dBA to a noise dose of zero, with the overall $\bar{L}_{OSHA}$ being 82.5 dBA. The results indicate that the drivers and wingmen are not exposed to sound levels in excess of the current Ministry of Labour regulations of 90 dBA for 8 h. On average, the wingmen were exposed to slightly higher sound levels than were the drivers.

Previous studies suggest that when the L_{OSHA} level is between 85 and 90 dBA, a hearing loss risk is present but is relatively low. If the L_{OSHA} level is above 90 dBA, there is a significant hearing loss risk present. The highest $\bar{L}_{OSHA}$ level measured in the present study was 85.5 dBA. This is getting into the range where hearing protectors should be made available to the worker, but their use should be voluntary.

The high standard deviation in the results indicates that they are quite variable and should be interpreted with caution. In addition, since it was not possible to have a technician in the truck, it is difficult to determine what was causing the noise exposure to the worker. This is why it becomes impossible to say what caused the dosimeters to indicate that sound levels in excess of 115 dBA were present as is listed in Tables 1 and 3. A further, more extensive study is necessary if the noise source is to be better defined for each truck and each operation. Some possible causes of the sound levels in excess of 115 dBA being indicated are the the door of the truck being slammed, bumping of the microphone, or voice communications between the driver and the wingman; but without a technician being present, this is only conjecture.

Results also indicate that there may be a relationship between age of truck and truck size, and L_{OSHA} levels. Newer and lighter trucks seem to be quieter than older and heavier ones.

Figure 1 shows a graphic level recording of an audio tape recording taken in an MTC snowplow driving on Highway 400 at approximately 80 km/h with the plow raised. In this case, a technician was in the vehicle and able to define the sound sources to which the highway equipment operator was exposed.

5/ CONCLUSIONS

- The L_{OSHA} sound levels measured were not above the current Ministry of Labour regulation of 90 dBA for 8 h and thus they could not be regarded as excessive.

- The workers should have hearing protection made available to them. Use should be on a voluntary basis.

- The workers were exposed to the short-duration sound levels in excess of 115 dBA from unknown sources. Sound levels of 115 dBA and over occurred approximately 20% of the time that sound measurements took place. These levels should not be considered excessive because they are taken into account in the calculation of L_{OSHA}.

- There appears to be a relationship between age of truck and truck size, and L_{OSHA} levels. Newer and lighter trucks seem to be quieter than older and heavier ones.

Table 1/ L_{OSHA} (dBA) of Snowplow Operators, Cookstown Yard

Truck Number	Position of Worker	Date 1982	L_{OSHA}	Sound Level Greater than 115 dBA
78-897-051	Driver	Feb. 3	77.4	Yes
		Feb. 9	91.1	Yes
		Feb. 19	62.2	No
		Mar. 9	72.7	Yes
78-897-051	Wingman	Feb. 3	88.6	Yes
		Feb. 9	81.1	No
		Feb. 19	*	No
		Mar. 9	77.7	No
72-226-068	Driver	Feb. 3	77.4	No
		Feb. 4	91.0	No
		Feb. 9	90.1	No
		Feb. 19	80.9	No
		Mar. 9	67.7	No
72-226-068	Wingman	Feb. 3	74.5	No
		Feb. 4	90.4	No
		Feb. 9	85.4	No
		Feb. 19	76.5	No
		Mar. 9	77.7	No

* No noise exposure dose recorded due to low sound levels.

Table 2/ Summary of Results in Cookstown Yard

Truck Number	Position of Worker	Number of Measurements	Average L_{OSHA} *	Standard Deviation
78-897-051	Driver	4	82.7	14.3
78-897-051	Wingman	4	83.9	5.9
72-226-068	Driver	5	85.5	10.6
72-226-068	Wingman	5	83.5	7.3

* Measurements of a noise dose percentage of zero are not included in the average calculations.

Table 3/ L_{OSHA} (dBA) of Snowplow Operators, Caledon Yard

Truck Number	Position of Worker	Date 1982	L_{OSHA}	Sound Level Greater than 115 dBA
80-148-051	Driver	Mar. 1	65.1	No
		Mar. 2	*	No
		Mar. 4	80.3	Yes
		Mar. 4	82.3	No
		Mar. 4	70.3	Yes
		Mar. 4	74.6	No
80-148-051	Wingman	Mar. 1	65.1	No
		Mar. 2	76.7	Yes
		Mar. 4	85.3	No
		Mar. 4	88.1	Yes
		Mar. 4	83.9	No
		Mar. 4	78.7	No
76-854-051	Driver	Mar. 4	*	No
		Mar. 4	81.1	No
		Mar. 4	82.7	No
76-854-051	Wingman	Mar. 4	79.1	No
		Mar. 4	86.8	No
		Mar. 4	80.4	No

* No noise exposure dose recorded due to low sound levels.

Table 4/ Summary of Results in Caledon Yard

Truck Number	Position of Worker	Number of Measurements	Average L_{OSHA} *	Standard Deviation
80-148-051	Driver	6	77.0	7.6
80-148-051	Wingman	6	82.5	8.9
76-854-051	Driver	3	82.3	0.6
76-854-051	Wingman	3	82.9	4.3

* Measurements of a noise dose percentage zero are not included in the average calculations.

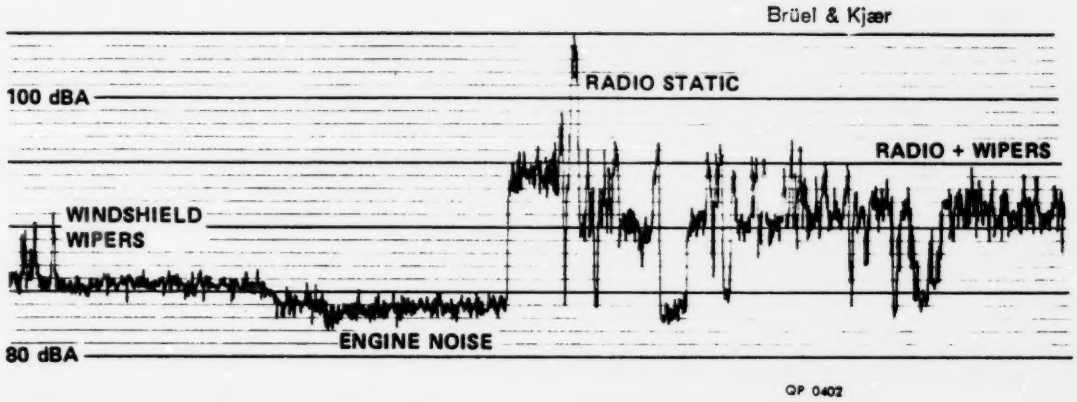
TABLE 5/ Average Sound Levels in Each Truck

Truck Number	Year of Manufacture	Number of Axles	Average L_{OSHA}	Average All Trucks
80-148-051	1980	1	80.2	
76-854-051	1976	1	82.4	
78-897-051	1978	1	83.2	
72-226-068	1972	2	84.5	
				82.5

TABLE 6/ Maximum Interior Sound Levels in Snowplows *

Truck Number	Type of Engine	Minimum Sound Level at Idle (dBA)	Maximum Sound Level Full Throttle (dBA)	Maximum RPM Obtained During Test
80-148-051	Diesel	71	82	3500
76-854-051	Diesel	66	82	3500
81-173-051	Diesel	72	86	2900
78-897-051	Diesel	80	87	2900
72-226-068	Gasoline	77	93	2900

* Stationary engine noise measured according to Canadian Standards Assocation, Standard Z107.23-M1977



WRITING SPEED = 250 mm/s
PAPER SPEED = 3 mm/s
25 dB POTENTIOMETER

Figure 1/ Sound Levels Measured in M.T.C. Truck Number 72–226–068